

York they were observed on nine, and in California, Illinois, New Jersey, and Virginia on ten dates. In Colo., Del., Ind. Ter., N. Mex., R. I., and W. Va. no lunar halos were reported. They were observed in the greatest number of states and territories (23) on the 11th; on the 9th in twenty-one, and on the 12th, 15th, and 19th, in seventeen. No lunar halos were reported on the 2d and 30th.

METEORS.

The distribution of meteors, by dates, was as follows: 1st, Somerset, Mass.; Columbia and Montague, Mich.; Rolling Green, Minn. 2d, Fort Sully, Dak.; Villa City and Mantanzas, Fla.; Lexington, Ky.; Farmington, Minn.; Nunnally, Tenn. 4th, Mesquite, Tex. 5th, Albany, Oregon. 7th, Egg Harbor City, N. J. 9th, Lead Hill, Ark.; Farmington, Minn.; Memphis, Tenn. 10th, Keeler, Cal.; Wauseon, Ohio; Nunnally, Tenn. 11th, Sumner, Ill.; Lebo, Kans. 12th, Vevay, Ind.; Manhattan, Kans.; Nashua, N. H.; Rio Grande, N. J. 14th, Nunnally, Tenn. 15th, Statesburgh, S. C. 21st, Lebo, Kans. 22d, Lebo, Kans.; Riddleton, Tenn. 24th, Willow Springs, Ariz.; Montrose, Colo.; New England City, Dak. 25th, Lake Forest, Ill.; Beverly, N. J.; Ilion, Setauket, South Canisteo, and Queensborough, N. Y.; Chambersburgh and Wellsborough, Pa. 26th, Fort Sully, Dak.; Villa City, Fla.; Wakefield, Kans. 28th, Fort Sully, Dak.; Corpus Christi, Tex. 29th, Parkston, Dak.; Lebo, Kans.; Mesquite, Tex. 30th, Flint, Mich. 31st, Lebo, Kans.

The following are more notable meteoric displays, noted chiefly on the 24th and 25th:

Rio Grande, N. J., 12th: a large meteor observed in the western sky, traveling very slowly towards the southeast. At times it shone very brilliantly, after which it would become very dim; it disappeared at 9.45 p. m. At 9.25 p. m., just before the meteor was seen, three distinct vibrations of my house were felt, each lasting about 30 seconds.—*Reported by Mr. William Bolton.*

Willow Springs, Ariz.: a brilliant meteor was observed, moving from northeast to southwest, at 8 p. m., 24th: several smaller ones were observed the same evening.

Montrose, Colo.: a brilliant meteor was reported to have passed across the sky from west to northeast at about 9 p. m., 24th; it was followed by a luminous trail.

Beverly, N. J.: a brilliant meteor passed slowly over this place in an easterly direction on the evening of the 25th; it burst into many fragments, like a rocket.

South Canisteo, N. Y.: a meteor was observed at 9 p. m., 25th, moving from south to northeast; it was followed by an unusually brilliant trail of light, of red and greenish colors.

Setauket, N. Y.: a very bright meteor, attended by a long trail of light, was observed at 9.10 p. m., 25th: it first appeared about 30° above the western horizon, moving northeastward. The meteor lighted up the surrounding country and finally exploded into four parts and disappeared.

Wellsborough, Pa.: a large and brilliant meteor was observed the evening of the 25th, passing from west to east; it moved slowly and appeared to burst into many pieces before reaching the eastern horizon. It flashed many brilliant colors.

Fort Sully, Dak.: a brilliant meteor was observed in azimuth 315°, altitude 45°, at 7.25 a. m., 28th; its course was almost

horizontal, and it disappeared in azimuth 290°. The meteor left a distinct trail of light which lasted a few seconds.

MIRAGE.

Poplar River, Mont.: a mirage was noticed in early forenoon of the 2d; distant ranges of hills in the north, which are ordinarily hidden from view, became distinctly visible, and appeared like islands in the midst of a body of water.

Mirage were also observed as follows: Garden City and Webster, Dak., 2d, 22d; Woonsocket, Dak., 20th, 21st, 24th, 25th, 28th; Parkston, Dak., 21st, 24th; Hampton, Iowa, and Genoa, Nebr., 7th; La Harpe, Kans., 17th.

SUN SPOTS.

Prof. F. P. Leavenworth, director, Haverford College Observatory, Pa. (observed by Mr. H. V. Gummere, assistant):

Date. January, 1889.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculae.		Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	
1, 2 p. m. ...	0	0	0	0	0	0	0	0	10	14	Definition good.
3, 11 a. m. ...	0	0	0	0	0	0	0	0	45	35	Definition good.
4, 12 m. ...	0	0	0	0	0	0	0	0	13	53	Definition good.
7, 10 a. m. ...	0	0	0	0	0	0	0	0	1	2	Definition very poor, clouds.
8, 11 a. m. ...	0	0	0	0	0	0	0	0	1	1	Definition poor.
10, 11 a. m. ...	0	0	0	0	0	0	0	0	4	6	Definition fair.
12, 11 a. m. ...	0	0	0	0	0	0	0	0	3	4	Definition poor.
14, 12 m. ...	0	0	0	0	0	0	0	0	0	0	Definition fair.
15, 12 m. ...	0	0	0	0	0	0	0	0	1	12	Definition poor.
16, 10 a. m. ...	1	8	0	0	0	0	1	8	2	22	Definition very good.
18, 10 a. m. ...	0	0	0	0	0	0	0	0	12	19	Definition very good.
19, 11 a. m. ...	0	0	0	0	0	0	0	0	0	0	Definition very poor.
21, 11 a. m. ...	0	0	0	0	0	0	0	0	4	5	Definition good; count of faculae stopped by clouds.
22, 11 a. m. ...	0	0	0	0	0	0	0	0	14	46	Definition very good.
23, 12 m. ...	0	0	0	0	0	0	0	0	10	39	Definition very good.
25, 11 a. m. ...	0	0	0	0	0	0	0	0	0	0	Definition poor.
29, 10 a. m. ...	0	0	0	0	0	0	0	0	0	0	Definition poor.
30, 11 a. m. ...	0	0	0	0	0	0	0	0	6	10	Definition good.
31, 11 a. m. ...	0	0	0	0	0	0	0	0	12	23	Definition good.

SAND STORMS.

Dodge City, Kans., 11th.

EARTHQUAKE.

Captain Walle, of the Norwegian bark "Beta," reports: "December 12, 1888, in N. 31° 44', W. 62° 16', at 2 a. m., wind ssw. to sw., blowing a gale; heavy rain and lightning; barometer, 29.90; air temperature, 73°; felt a heavy earthquake shock, lasting two minutes. The sensation was that of a ship striking the ground in smooth water and jumping her way over it. At the same time a shower of ashes fell, which appeared to be black or dark grey; was unable to obtain a sample as they were washed away by the heavy rain. After the shock the barometer rose to 30.00."

SNOW FROM A CLOUDLESS SKY.

Dysart, Iowa: snow began at 5.20 a. m., 31st, and continued twenty-five minutes; it fell in sufficient quantity to cover the ground. The stars were seen to the horizon, and no cloud was visible at the time.

VERIFICATIONS.

INDICATIONS FOR 24 HOURS IN ADVANCE.

The percentages of verifications of the 8 p. m. daily indications for January, 1889, as determined from comparison of succeeding telegraphic reports, are given in the table below.

The predictions for districts east of the Rocky Mountains for

January, 1889, were made by Capt. Robert Craig, Assistant Quartermaster, U. S. Army, Acting Signal Officer and Assistant, and those for the Pacific Coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Assistant Professor C. F. Marvin.

Percentages of indications verified, January, 1889.

States.		States.	
Maine	84.4	Tennessee	80.6
New Hampshire	87.0	Kentucky	81.9
Vermont	83.8	Ohio	81.7
Massachusetts	83.4	West Virginia	85.6
Rhode Island	84.9	Indiana	83.2
Connecticut	85.6	Illinois	85.5
Eastern New York	84.3	Lower Michigan	81.9
Western New York	80.3	Upper Michigan	83.4
Eastern Pennsylvania	90.3	Wisconsin	81.5
Western Pennsylvania	84.3	Minnesota	82.7
New Jersey	88.2	Iowa	81.9
Delaware	88.6	Kansas	87.2
Maryland	90.2	Nebraska	83.5
District of Columbia	90.6	Missouri	88.1
Virginia	91.4	Colorado	82.1
North Carolina	87.8	Dakota	78.5
South Carolina	86.0	Southern California*	95.2
Georgia	83.7	Northern California*	83.9
Eastern Florida	84.8	Oregon*	83.6
Western Florida	83.5	Washington Territory*	81.1
Alabama	84.1	By elements: Weather	87.0
Mississippi	81.8	Temperature	81.6
Louisiana	86.5		
Texas	84.9	Monthly percentage of weather and temperature combined†	84.8
Arkansas	88.3		

* In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. † The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.

CAUTIONARY SIGNALS FOR JANUARY, 1889.

Statement showing percentages of justifications of wind signals and cold-wave signals for the month of January, 1889: *Wind signals.*—(Ordered by Captain Robert Craig.) Total

number of signals ordered, ninety-five; justified as to velocity, wholly, sixty-six, partly, five; justified as to direction, eighty-nine. Of the signals ordered, forty were cautionary, of which twenty-one were wholly, and three partly justified; fifty-five were storm, of which forty-five were wholly, and two partly justified. Thirty-nine were ordered for easterly winds, of which thirty-six were justified, and fifty-six were ordered for westerly winds, of which fifty-three were justified. Ten signals were ordered late. Number of winds without signals, eighteen. Percentage of justifications, 71.6.

Cold-wave signals.—(Ordered by Assistant Prof. T. Russell.) Total number of signals ordered, three hundred and ninety-three; number wholly justified, two hundred and fifteen, of which eight were ordered late. Number partly justified, thirteen. Number of severe cold waves without signals, twenty-four. Percentage of justifications, 55.0.

Percentages of local verifications of weather and temperature signals as reported by directors of the various State Weather Services for January, 1889.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois	86.0	81.0	Nebraska	91.0	85.0
Indiana	87.3	83.3	New Jersey	88.0	84.6
Kansas	91.3	82.5	New York	85.0	79.0
Kentucky	84.0	83.0	North Carolina	85.0	79.0
Louisiana (northern)	88.0	92.0	Ohio	90.0	86.0
Louisiana (southern)	80.0	80.0	South Carolina	72.2	81.0
Michigan	83.1	81.5	Tennessee	83.6	77.1
Minnesota and eastern Dakota	83.0	77.0	Texas	88.0	87.0

STATE WEATHER SERVICES.

[Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.]

The following extracts are republished from reports for January, 1889, of the directors of the various state weather services:

ALABAMA.

The month was uniformly cooler than the average January, but there were few decidedly cold days. The temperature was 3.1 below the normal.

At most stations the precipitation was in excess of the normal. This was particularly true in a belt passing through middle Alabama. Rain fell frequently during the month. There was a slight fall of snow on the 28th, but, soon melting, its effects were inappreciable. The average precipitation was 0.55 above the normal.

Summary.

Temperature.—Monthly mean, 44.1; highest monthly mean, 50.4, at Tuscaloosa; lowest monthly mean, 40, at Florence; maximum, 81, at Troy, 17th; minimum, 17, at Motes, 29th; range for state, 64; greatest local monthly range, 69, at Troy; least local monthly range, 37, at New Market.

Precipitation.—Average for the state, 6.11; greatest, 9.48, at Auburn; least, 3.64, at Butler.

Wind.—Prevailing direction, northwest.—P. H. Mell, Signal Corps, Auburn, director.

ARKANSAS.

Summary.

Temperature.—Monthly mean, 41.6; highest monthly mean, 46.5, at Galveston; lowest monthly mean, 36.8, at Dallas; maximum, 79, at Washington, 17th; minimum, 6, at Eureka Springs, 28th; range for state, 74; greatest local monthly range, 81, at Eureka Springs; least local monthly range, 28, at Dallas.

Precipitation.—Average for the state, 5.78; greatest, 8.48, at Washington; least, 3.09, at Atlas.—Prof. John C. Branner, Little Rock, director; W. U. Simons, Corporal, Signal Corps, assistant.

COLORADO.

Summary.

Temperature.—Monthly mean, 18.1; highest monthly mean, 30.4, at Cañon City; lowest monthly mean, 8.1, at Gunnison; maximum, 70, at Breckenridge, 14th; minimum, —25, at Saguache, 1st; range for state, 95; greatest local monthly range, 49.5, at Breckenridge; least local monthly range, 15.1, at Georgetown.

Precipitation.—Average for the state, 0.29; greatest, 1.24, at Glenwood Springs; least, trace, at Thon.—Prof. F. H. Loud, Colorado Springs, director; T. W. Sherwood, Corporal, Signal Corps, assistant.

ILLINOIS.

The remarkably high temperature of the present winter has continued through January and was even more marked than during December. The

mean temperature, 30.7, was 8.5 above the mean of the previous eleven Januarys, and though largely in excess of the average cannot be said to have been phenomenally so, as it has been exceeded twice in the previous eleven years, in 1878 when it was 31.0, and in 1880 when it was 41.8.

The precipitation was slightly above the average; 0.20 above that of the eleven preceding Januarys, being lightest in northern and heaviest in the southern division. In the northern division it was mainly in the form of snow but in the other two the greater part of it was in rain. From 5 to 10 inches of snow fell in the western division and considerably less in the other divisions, but owing to the high temperature and the dryness of the atmosphere it soon disappeared and only traces remained at the end of the month. A general thunder-storm extended over the northern division on the 16th.

Wind.—Prevailing direction, southwest and northwest.—Col. Charles F. Mills, Springfield, director; James Cassidy, Sergeant, Signal Corps, assistant.

INDIANA.

Temperature.—The temperature during the month was uniformly high and its mean the highest noted since 1880, when the mean temperature for the state was 45.9, surpassing, by far, the mean, 32.5, of January, 1883. The mean temperature of January, 1874, 35.5, 1876, 38.6, and 1878, 34.5, were also much above the mean of the current month. The departure of the mean temperature for January, 1889, from the normal of six years is about +8 and from the normal of eighteen years, or more, about +5. At no time during the month, and, in fact during the winter, so far, has the temperature been reported 0. or below. The highest temperature was noted nearly everywhere on the 16th, and the lowest on the 21st.

Precipitation.—The precipitation for the state was slightly below the normal; it was below in the central and northern portions, more so in the latter, and slightly above the normal in the southern portion; it was badly distributed and the total measurements differ materially.—Prof. H. A. Huston, La Fayette, director; C. F. R. Wappenhans, Sergeant, Signal Corps, assistant.

IOWA.

The month was fine and decidedly warm, westerly winds prevailing. Precipitation was normal, and mainly in the form of rain. The mean temperature was nearly 5 above normal. During the six years just preceding, January has been from 8 to 14 below normal, forming the coldest series on record for the state and the upper Mississippi valley; the mean of the preceding six Januarys is more than 10 below normal, consequently, the current month was nearly 15 above the average of the same month of the preceding six years. January, 1880, was over 10 warmer than the month just passed, and was the warmest January noted for the past fifty years. Since 1860, January has been five times as warm or warmer than in this year, namely, in 1880, 1878, 1876, 1869, and 1868, averaging once in four years. At the Central Station the